

Selection Statement  
For  
Commercial Crew Development Round 2  
(Announcement Number NASA-CCDev-2)

On March 25, 2011, along with other senior officials of the National Aeronautics and Space Administration (NASA), I met with the Participant Evaluation Panel (PEP) appointed to evaluate proposals submitted in response to the Commercial Crew Development Round 2 (CCDev 2) Announcement (Announcement Number NASA-CCDev-2).

**I. Background and Evaluation Process**

In 2009, NASA began the Commercial Crew Development (CCDev) initiatives to stimulate efforts within the private sector to develop system concepts and capabilities that could ultimately lead to the availability of commercial human spaceflight services. NASA is continuing that effort through a second round of CCDev initiatives in order to further foster activity leading to the development of orbital commercial Crew Transportation Systems (CTS). Through this CCDev 2 activity, NASA may be able to continue to spur economic growth as capabilities for new space markets are created, and reduce the gap in U.S. human spaceflight capability.

The Announcement solicited proposals to further advance orbital commercial CTS concepts and enable significant progress on maturing the design and development of elements of the system, such as launch vehicles and spacecraft, with the overall objective of accelerating the availability of U.S. CTS capabilities while ensuring crew and passenger safety. Selected CCDev 2 participants will receive funded Space Act Agreements under NASA's Other Transactions Authority within the National Aeronautics and Space Act, 51 U.S.C. 20101 *et seq.* NASA is selecting a portfolio of multiple CCDev 2 agreements that best meet the CCDev 2 goals and objectives within the available funding. The agreements are expected to result in significant maturation of commercial CTS capabilities with consideration given to NASA's draft human certification requirements and standards or industry equivalent to those requirements and standards. In order to open up the design trade space, encourage innovations and efficiencies in system design solutions, NASA did not dictate specific system goals or system concepts. Each participant determined the system requirements for its proposed concept that best served its target markets.

The Announcement was released on October 25, 2010. It divided the proposals into three sections with one appendix, all due on December 13, 2010. Section I was an Executive Summary, Section II was the Technical Approach, and Section III required Business Information. The appendix contained a proposed Space Act agreement. Proposals were received from the following companies (participants):

alphaSpaces (ΩSpaces)  
Andrews Space  
ATK Aerospace Systems  
Blue Origin  
The Boeing Company

Orbital Sciences Corporation  
Orbital Space Transport, LLC  
Paragon Space Development Corporation  
PlanetSpace, Inc.  
Sierra Nevada Corporation

Excalibur Almaz Incorporated  
ILC Dover  
Innovative Space Propulsion Systems, LLC  
KT Engineering  
Oceaneering International, Inc.  
Orbital Outfitters

Spacedesign Corporation  
Space Exploration Technologies Corporation  
TGV Rockets, Inc.  
Transformational Space Corporation  
United Launch Alliance , LLC  
United Space Alliance , LLC

Upon receipt, the Agreements Officer conducted an acceptance screening to confirm that each proposal complied with the proposal instructions and met the intent of the requirements and goals of the Announcement.

The proposal from alphaSpaces did not pass the acceptance screening because it failed to comply with the proposal instructions in the Announcement and was, therefore, not reviewed by the voting members.

The evaluation and selection were conducted using a four-step process.

- Step 1 – Initial Evaluation
- Step 2 – Due Diligence
- Step 3 – Portfolio Selection
- Step 4 – Finalize Space Act Agreements

Step 1 was an evaluation of each proposal that passed the acceptance screening and on its Business Information and Technical Approach sections on a stand-alone basis without comparison to other proposals. The voting members of the Participant Evaluation Panel (PEP) first read each proposal to determine whether it met the intent of the requirements and goals of the Announcement. If, after reading the entire proposal, it determined that the proposal failed to meet the intent of the Announcement in either the Technical Approach or Business Information sections, then it received a red level of confidence rating for that section. Proposals that received a red rating in either Business Information or Technical Approach were eliminated from further evaluation.

Based on the voting members' review, the following ten proposals were eliminated from further evaluation:

Andrews Space; ILC Dover; Innovative Space Propulsion Systems, LLC; Oceaneering International, Inc.; Orbital Outfitters; and Paragon Space Development Corporation submitted proposals which described development of lower level subsystems, but failed to show solid commitments from element providers to confirm how the participant's lower level subsystem is connected to or would accelerate the availability of an identified element, either spacecraft or launch vehicle, of a CTS concept.

KT Engineering submitted a proposal that was not found to accelerate the development of a commercial crew transportation concept within the timeframe of the CCDev 2 Space Act agreement.

TGV Rockets, Inc. submitted a proposal that lacked sufficient detail in the Technical Approach and Business Information sections for the PEP to be able to perform a comprehensive review, which led the PEP to determine that this proposal failed to meet the intent and goals of the Announcement.

Spacedesign Corporation submitted a proposal that contained multiple and significant weaknesses in the Technical Approach and Business Information sections, which presented significant risk in the completion of the proposed project.

United Space Alliance, LLC submitted a proposal that did not fall within the scope or intent of the CCDev 2 effort to advance orbital commercial CTS concepts and mature the design and development of elements of a system such as launch vehicles or spacecraft during the CCDev 2 timeframe, and withdrew its proposal on March 28, 2011.

The PEP members and the rest of the evaluation team then read each proposal not previously eliminated by the voting members of the PEP. Evaluators identified the distinguishing factors of each proposal, which were documented as findings of strengths and weaknesses. The Business Information and Technical Approach team leads each convened a meeting of the evaluation team to review all findings in their respective areas, and prepared team findings representing their respective areas along with a recommended level of confidence rating for that area based upon the team findings. The team leads then presented the proposed team findings and color rating recommendations for their respective areas to the PEP, which, through consensus, finalized the findings and determined the level of confidence ratings to be applied to the Technical Approach and Business Information sections for each proposal.

There are five Level of Confidence color ratings:

Blue: Very High Level of Confidence – The proposal section is very highly effective and there is a very high likelihood of successful execution.

Green: High Level of Confidence – The proposal section is highly effective and there is at least a high likelihood of successful execution.

White: Moderate Level of Confidence – The proposal section is moderately effective and there is at least a moderate likelihood of successful execution.

Yellow: Low Level of Confidence – The proposal section has low effectiveness or there is a low likelihood of successful execution.

Red: Very Low Level of Confidence – The proposal section has very low effectiveness or there is a very low likelihood of successful execution.

After all stand alone evaluations were completed, the PEP determined the proposals most favorably evaluated as candidates for further due diligence. All other proposals received no further evaluation at this point but their evaluation results were presented to me during Step 3, Portfolio Selection.

In Step 2, the PEP conducted face-to-face due diligence meetings with participants whose proposals were most favorably evaluated. During these meetings, participants presented their overall CCDev proposed approach, responded to the initial evaluation findings and questions

submitted to them by NASA, and resolved issues associated with draft Space Act agreements and their proposed performance milestones. After completion of the due diligence meetings, the PEP reconvened to modify or amend the consensus evaluation findings based on any new information obtained that may have impacted the initial evaluation results and assigned final level of confidence ratings based on the final consensus findings.

In Step 3, the PEP presented to me a summary of the proposal evaluations. This included the PEP's analysis and recommendation for selecting one or more of the proposals for award and the respective amount of NASA contribution to be offered. After selection, the final step of the competitive process will be to sign the Space Act agreements negotiated with the selected participant(s).

## **II. Initial Evaluation**

Eleven proposals passed the initial voting member evaluation screening and were evaluated by the full evaluation team. Each proposal received two level of confidence ratings, one for the Technical Approach section and one for the Business Information section, based on the consensus findings prepared using the distinguishing factors (strengths or weaknesses) in the proposal.

### **ATK Aerospace Systems (ATK)**

For the Technical Approach evaluation, ATK received a level of confidence of **Yellow**. Strengths included significant performance capability for a variety of crew capsules and lifting bodies; use of relatively mature systems to support a range of users; extensive experience in using its risk management approach; a comprehensive set of maturation plan activities to develop and test high-risk development areas during CCDev 2; and an understanding of NASA's draft human certification requirements. Weaknesses included insufficient details to assess new launch vehicle flight stress environments; insufficient information about the development and integration of emergency detection and abort system concepts; insufficient definition of system level responsibility for integration of a spacecraft with the launch vehicle and ground systems; unsubstantiated Technology Readiness Level (TRL) for certain components; failure to include risks related to spacecraft integration during CCDev 2 timeframe; insufficient detail to address technical and schedule complexities of integrating launch vehicle stages; overly optimistic design schedule; lack of demonstration of effective and integrated S&MA organizational structure; use of safety & mission assurance processes to reduce risks not tied to proposed performance milestones or design review milestones; lack of information to assess validity of integrated Loss of Crew and Loss of Mission assertion; insufficient data on effort to certify the vehicle for human space flight; and inadequate definition of performance milestone success criteria.

For the Business Information evaluation, ATK received a level of confidence rating of **Yellow**. Strengths included management team with extensive human space flight experience and extensive in-place labor and facilities. Weaknesses included proposed teaming structure; lack of information on cost and risk assessments of requested government resources; insufficient information to demonstrate compliance with the Commercial Space Act and U.S. National Space Policy.

## Blue Origin

For the Technical Approach evaluation, Blue Origin received a level of confidence of **Yellow**. Strengths included proposed concept offers significant operational capability; concept provides flexibility for optimizing crew and cargo up-mass and down-mass; risk retirement concept; critical tests of the launch escape system during CCDev 2 timeframe; effective and integrated S&MA organizational structure; dissimilar redundancy in flight control for critical flight phases; and well defined objective success criteria for performance milestones. Weaknesses included identified capabilities do not mature TRLs appreciably during timeframe of agreement; insufficient information to evaluate proposed reusability; lack of discussion on integration and human certification of launch vehicle; failure to identify long term development risks; lack of detail on subsystem mass margins; lack of specificity on maturation of space vehicle design during CCDev 2 timeframe; unclear definition of abort scenarios; investments may not advance development of a CTS capability; lack of overall development plan; safety & mission assurance processes to reduce risks not appropriately associated with proposed performance milestones or design review milestones; lack of detail to assess controllability of spacecraft with proposed escape system; lack of understanding of NASA's draft human certification requirements or industry equivalent; and certain performance milestones have inadequately defined success criteria.

For the Business Information evaluation, Blue Origin received a level of confidence rating of **White**. Strengths included a creative and marketable business strategy; financial resources to fund its CCDev 2 effort; and significant infrastructure and facilities investments. Weaknesses included lack of financial information; some requested investment does not relate to acceleration of CTS capability; and lack of information on cost and risk assessments of requested government resources.

## The Boeing Company (Boeing)

For the Technical Approach evaluation, Boeing received a level of confidence of **White**. Strengths included an efficient propulsion system; landing concept offers significant operational capability; use of non-toxic propellant for crew module; design and manufacturing for re-use of crew module; flexibility for optimizing crew and cargo up-mass and down-mass; processes for identifying, evaluating, and documenting risks during CCDev 2 and for the overall program; early human factors assessments and demonstrations; approach and activities for maturing capabilities during CCDev 2; comprehensive S&MA approach for each S&MA discipline; dissimilar redundancy for critical flight phases; and use of reliability analyses in approach to achieving human certification. Weaknesses included failure to address integration or human certification of the launch vehicle; limited on-orbit capability; docking system inconsistent with NASA baselined system; failure to address risks associated with certifying vehicle for multiple uses; overly optimistic design schedule; lacks demonstration of effective and integrated S&MA organizational structure; insufficient information to assess controllability of spacecraft with a launch abort system; failure to identify risks and associated mitigation strategies for crew module depressurization or fore; safety & mission assurance processes to reduce risks not appropriately associated with proposed performance milestones or design review milestones;

insufficient engine testing; large comprehensive set of non-prioritized interrelated milestones; inadequate definition of performance milestone success criteria; inadequate traceability from performance milestones to design review milestone progress.

For the Business Information evaluation, Boeing received a level of confidence rating of **Yellow**. Strengths included low-risk and marketable business strategy; management team with extensive human space flight experience; reasonable development and demonstration cost estimates; and strong teaming arrangement. Weaknesses included requested investment exceeded amount stated in the Announcement and failure to provide requested pro-forma information.

#### Excalibur Almaz Incorporated (EAI)

For the Technical Approach evaluation, EAI received a level of confidence of **Yellow**. Strengths included leveraging of an existing crew vehicle structure; landing concept offers significant operational capability; processes for identifying, evaluating, and documenting risks during CCDev 2 and for the overall program; and effective and integrated S&MA organizational structure. Weaknesses included insufficient detail on breadth and depth of engineering and manufacturing experience; insufficient data on heritage hardware pedigree; insufficient information on quantity of hardware and relationship to flight/test plans; insufficient information on the integration of systems; insufficient information on proposed launch abort system; failure to address development risks for certain component development; some proposed tasks not shown to advance a CTS capability; failure to map key development risks to proposed milestones; insufficient detail to assess applicability and adaptability of legacy design to commercial crew; lack of understanding of NASA's draft human certification requirements or industry equivalent; safety & mission assurance processes to reduce risks not appropriately associated with proposed performance milestones or design review milestones; and inadequate definition of performance milestone success criteria.

For the Business Information evaluation, EAI received a level of confidence rating of **Yellow**. No strengths were identified. Weaknesses included inadequate information about acquisition of hardware, relationship to supplier, and projected revenues; unclear source of CCDev 2 investment; lack of information about the total amount of funding needed for development of capability; insufficient detail to show that stated resources are in place; insufficient information about experience with suppliers and teaming arrangements; and insufficient information on INKSNA compliance.

#### Orbital Sciences Corporation (OSC)

For the Technical Approach evaluation, OSC received a level of confidence of **White**. Strengths included significant operational capability of proposed concept; heritage design and development of spacecraft design; simple, robust launch abort system; on-orbit flight margin; thorough understanding of technical and programmatic risks and tasks; comprehensive architecture and organized overall approach; demonstration of effective and integrated S&MA organizational structure; comprehensive S&MA approach for each S&MA discipline; demonstrated understanding of NASA's draft human certification requirements; dissimilar redundancy and failure tolerance in key areas; and inadequate definition of performance

milestone success criteria. Weaknesses included failure to address the integration or human certification of the launch vehicle; insufficient information to evaluate spacecraft reusability; insufficient rationale for baselining life support system; insufficient detail on accommodation of de-conditioned crew members during entry and landing; failure to prioritize significant development risks and CCDev 2 activities; overly optimistic design schedule; insufficient information to assess controllability of spacecraft with a launch abort system; failure to address elimination of black zones during launch abort scenarios; safety & mission assurance processes to reduce risks not appropriately associated with proposed performance milestones or design review milestones; and inadequate definition of performance milestone success criteria.

For the Business Information evaluation, OSC received a level of confidence rating of **White**. Strengths included strong management team highly experienced in human spaceflight; reasonable development and demonstration cost estimates; and experienced and knowledgeable suppliers. Weaknesses included failure to provide requested financial information and lack of information on cost and risk assessments of requested government resources.

#### Orbital Space Transport, LLC (OST)

For the Technical Approach evaluation, OST received a level of confidence of **Red**. The only strength found related to the heritage design and development of spacecraft design. Weaknesses included insufficient information to evaluate proposed overall subsystem design, mass margin, and manufacturing capability; insufficient information to evaluate proposed reusability of spacecraft; development of docking system during CCDev 2 does not significantly accelerate CTS capability; failure to address integration or human certification of the launch vehicle; insufficient information to evaluate critical systems; insufficient detail on accommodation of de-conditioned crew members during entry and landing; insufficient data on maturation plan for spacecraft and launch abort system; overly optimistic design schedule; failure to demonstrate an effective and integrated S&MA organizational structure; failure to adequately describe association of standard S&MA processes with proposed performance milestones or major design milestones; failure to address abort conditions; inadequate definition of performance milestone success criteria; and failure of proposed performance milestones to clearly demonstrate significant progress on maturing design and development during CCDev 2.

For the Business Information evaluation, OST received a level of confidence rating of **Red**. No strengths were identified. Weaknesses included insufficient information to substantiate participant's long-term viability; failure to provide requested financial information; intellectual property is not currently in place and facilities are limited; lack of information on cost and risk assessments of requested government resources; insufficient detail on personnel resources; lack of information on cost and risk assessments of requested government resources; and lack of detail on proposed teaming arrangements

#### PlanetSpace, Inc.

For the Technical Approach evaluation, PlanetSpace received a level of confidence of **Red**. The only strength found related to proposed leveraging of heritage elements from existing vehicles into the spacecraft. Weaknesses included insufficient detail to evaluate overall concept and

architecture; failure to address integration and human certification of launch vehicle; insufficient detail to evaluate proposed docking system; insufficient information to evaluate overall programmatic and system risks approach; insufficient information to support assumptions that components are based on proven designs; insufficient information to evaluate proposed maturation schedule with critical subsystem development and integration activities; insufficient detail to address technical and schedule complexities in integration of spacecraft and launch vehicle; failure to adequately describe association of standard S&MA processes with proposed performance milestones or major design milestones; insufficient detail to evaluate abort engine and overall abort system maturity; and inadequate definition of performance milestone success criteria.

For the Business Information evaluation, PlanetSpace received a level of confidence rating of **Red**. The only strength identified related to experienced and knowledgeable teammates. Weaknesses included insufficient detail to show available sources of income to implement proposed business strategy; insufficient information to show financial resources will be available during CCDev 2; insufficient detail to show foreign and domestic facility integration to meet proposed launch schedule; lack of information on cost and risk assessments of requested government resources; and failure to show understanding of FAA commercial space transportation licensing process.

#### Sierra Nevada Corporation (SNC)

For the Technical Approach evaluation, SNC received a level of confidence of **White**. Strengths included significant operational capability of proposed concept; heritage spacecraft design; ground and flight features reduce operational costs, increase system efficiency, and mitigate risk; on-orbit flight margin; flexibility for optimizing crew and cargo up-mass and down-mass; processes for identifying, evaluating, and documenting risks during CCDev 2 and for the overall program; concept to retire system risks during CCDev 2; thorough and logical maturation plan; demonstrated understanding of NASA's draft human certification requirements; dissimilar redundancy for critical flight phases; and NASA insight into most development activities. Weaknesses included failure to address the integration or human certification of the launch vehicle; insufficient information to evaluate spacecraft reusability; failure to identify risks associated with Centaur modifications; failure to describe subsystem mass margins; failure to address risks associated with motors; insufficient detail on accommodation of de-conditioned crew members during entry and landing; little improvement in Technology Readiness Levels during CCDev 2; overly optimistic design schedule; failure to identify the abort system development as a risk; failure to demonstrate an effective and integrated S&MA organizational structure; proposed timing of S&MA emphasis and integration; failure to adequately describe association of standard S&MA processes with proposed performance milestones or major design milestones; and failure of proposed performance milestones to clearly demonstrate significant progress on design and development during CCDev 2.

For the Business Information evaluation, SNC received a level of confidence rating of **White**. Strengths included reasonable development and demonstration cost estimates, and teaming with experienced and knowledgeable suppliers. Weaknesses included lack of relevant human space



flight experience; failure to provide requested financial information; and lack of information on resources planned for CCDev 2 work.

#### Space Exploration Technologies Corporation (SpaceX)

For the Technical Approach evaluation, SpaceX received a level of confidence of **White**. Strengths included use of flight demonstrated hardware and number of flights of system prior to crewed flight; an efficient propulsion system for abort and on-orbit maneuvering; proposed launch vehicle allows for true “test-like-you-fly” operations; comprehensive description of risk selection methodology; successful attainment of FAA license for entry and landing of a spacecraft; development of a draft crew certification plan during CCDev 2; demonstration of effective and integrated S&MA organizational structure; comprehensive S&MA approach for each S&MA discipline; and dissimilar redundancy for critical flight phases. Weaknesses included insufficient detail on landing and recovery plans; failure to address integration or certification of launch vehicle; insufficient data to determine launch abort system performance; failure to identify long term development risks; proposed mitigation for integration of the launch abort system and crew accommodations; plan to conduct launch abort engine CDR prior to building test article; insufficient information on the scope and success criteria for launch abort engine/system development; overly optimistic design schedule; insufficient detail to assess controllability of spacecraft with a launch abort system; inadequate definition of performance milestone success criteria; and insufficient information on skills balance to support various NASA and commercial space missions.

For the Business Information evaluation, SpaceX received a level of confidence rating of **Green**. Strengths included viable capabilities and a creative and marketable business strategy; significant facility investments; and teaming with experienced and knowledgeable suppliers. Weaknesses included unclear financial investment in CCDev 2 and correlation between milestones and stated program priorities is unclear.

#### Transformational Space Corporation (t/Space)

For the Technical Approach evaluation, t/Space received a level of confidence of **Red**. Strengths included proposed system’s entry mode; design concept that maximizes abort capability and minimizes overall weight; proposed systems reduce vehicle complexity; and utilization of dissimilar redundancy and failure tolerant system. Weaknesses included failure to provide analysis for off-nominal landing calculations and other FAA license related analyses; insufficient information to substantiate proposed redundancy of the primary structure and thermal protection system; unrestrained crew during portions of entry \landing; insufficient detail to evaluate overall launch vehicle integration; insufficient information on technology readiness levels, performance specifications, and technical risks of the launch-escape-integral-abort system; insufficient information to evaluate reusability of the spacecraft; proposed vehicle recovery system; insufficient information to evaluate overall programmatic and system risks; insufficient detail on accommodation of de-conditioned crew members during entry and landing; insufficient detail to evaluate integrated maturation plan; failure to provide concrete S&MA plans, tasks, processes, analysis, and deliverables to develop safe and reliable crewed spacecraft; failure to adequately describe association of standard S&MA processes with proposed

performance milestones or major design milestones; and inadequate definition of performance milestone success criteria.

For the Business Information evaluation, t/Space received a level of confidence rating of **Red**. No strengths were identified. Weaknesses included failure to provide monetary investment in CCDev 2 efforts as required by the Announcement; management team lacks demonstrated space flight integration experience; insufficient information to demonstrate availability of facilities and personnel; and insufficient information to demonstrate commitment of proposed team members.

#### United Launch Alliance, LLC (ULA)

For the Technical Approach evaluation, ULA received a level of confidence of **White**. Strengths included use of existing flight proven vehicles and infrastructure; adaptable emergency detection system; and performance capability for crew abort scenarios. Weaknesses included insufficient data to understand impacts of Centaur modification; insufficient definition of the systems level responsibility for integration of a spacecraft and launch vehicle; insufficient detail to evaluate if all Centaur modifications and related risks have been identified; lack of definition of critical path to an initial launch capability and correlation to CCDev 2 efforts; failure to demonstrate an effective and integrated S&MA organizational structure; failure to demonstrate an understanding of NASA's draft human certification requirements or an industry equivalent; failure to adequately describe association of standard S&MA processes with proposed performance milestones or major design review milestones; and inadequate definition of performance milestone success criteria.

For the Business Information evaluation, ULA received a level of confidence rating of **White**. Strengths included suitability to deliver proposed capabilities; strong, highly experienced management team; facilities needed for CCDev 2 already in place; and experienced and knowledgeable suppliers. Weaknesses included inadequate description of commercial space transportation markets; failure to provide requested financials; failure to state total amount of funding required for full development and demonstration of system; and failure to adequately address laws and policy in Section 4.3 of the Announcement.

### **III. Final Evaluation after Due Diligence**

In accordance with the Announcement and Evaluation Plan, the most favorably evaluated proposals were selected for due diligence. Eight proposals went through due diligence: ATK Aerospace Systems, Blue Origin, The Boeing Company, Excalibur Almaz Inc., Orbital Sciences Corp., Sierra Nevada Corp., Space Exploration Technologies Corp., and United Launch Alliance LLC. Three proposals did not receive any further evaluation: Orbital Space Transport LLC, PlanetSpace Inc., and Transformational Space Corporation.

The PEP modified the consensus findings and level of confidence color ratings based on the results of further due diligence. These final evaluation summaries and confidence ratings were presented to me on March 25, 2011 and are summarized below.

### ATK Aerospace Systems (ATK)

For the Technical Approach evaluation, the level of confidence rating changed from **Yellow** to **Green**. There were three new strengths identified for an effective and integrated S&MA organizational structure; concretely tying S&MA processes to milestone reviews; and a comprehensive plan of certifying existing space hardware. All weaknesses were fully addressed, except for providing insufficient details to assess new launch vehicle flight stress environments.

For the Business Information evaluation, the level of confidence rating changed from **Yellow** to **Green**. There was one new strength identified for demonstrating viable capabilities and a marketable business strategy. All weaknesses were fully addressed.

### Blue Origin

For the Technical Approach evaluation, the level of confidence rating changed from **Yellow** to **White**. There was one new strength identified for demonstrating an understanding of NASA's draft human certification requirements. All weaknesses were fully addressed, except for insufficient information to evaluate proposed reusability; failure to identify long term development risks; lack of specificity on maturation of space vehicle design during CCDev 2 timeframe; investments may not accelerate development of a CTS capability; and safety & mission assurance processes to reduce risks not appropriately associated with proposed performance milestones or design review milestones.

For the Business Information evaluation, the level of confidence rating changed from **White** to **Green**. No new strengths were identified. All weaknesses were fully addressed, except for a lack of information on cost and risk assessments of requested government resources.

### The Boeing Company (Boeing)

For the Technical Approach evaluation, the level of confidence rating changed from **White** to **Blue**. Three new strengths were identified for reflecting an effective and integrated S&MA organizational structure; providing detailed analysis and rationale to assess the controllability of spacecraft with a launch abort system; and for concretely tying S&MA processes to milestone reviews. All weaknesses were fully addressed, except for a limited on-orbit duration capability.

For the Business Information evaluation, the level of confidence changed from **Yellow** to **Green**. No new strengths were identified. All weaknesses were fully addressed, except for failing to provide requested pro-forma information.

### Excalibur Almaz Incorporated (EAI)

For the Technical Approach evaluation, the level of confidence rating changed from **Yellow** to **White**. There was one new strength identified for demonstrating an understanding of NASA's draft human certification requirements. All weaknesses were fully addressed, except for insufficient detail on breadth and depth of engineering and manufacturing experience; insufficient data on heritage hardware pedigree; insufficient information on the integration of

systems; and safety & mission assurance processes to reduce risks not appropriately associated with proposed performance milestones or design review milestones.

For the Business Information evaluation, the level of confidence rating remained **Yellow**. No new strengths were identified. All weaknesses were fully addressed, except for weaknesses related to inadequate information about acquisition of hardware, relationship to supplier, and projected revenues; insufficient detail that stated resources are in place; and unclear source of CCDev 2 investment.

#### Orbital Sciences Corporation (OSC)

For the Technical Approach evaluation, the level of confidence rating changed from **White** to **Green**. No new strengths were identified. All weaknesses were fully addressed, except for the weakness related to an overly optimistic design schedule.

For the Business Information evaluation, the level of confidence rating remained **White**. There were no new strengths. All weaknesses were fully addressed, except for the lack of information on cost and risk assessments of requested government resources.

#### Sierra Nevada Corporation (SNC)

For the Technical Approach evaluation, the level of confidence rating remained **White**. There are no new strengths identified. All weaknesses were fully addressed, except for weaknesses related to little improvement in Technology Readiness Levels during CCDev 2; an overly optimistic design schedule; failure to identify abort system development as a risk; failure to demonstrate an effective and integrated S&MA organizational structure; and the proposed timing of S&MA emphasis and integration.

For the Business Information evaluation, the level of confidence rating changed from **White** to **Green**. There was one new strength identified for demonstrating a history of operational performance, stable leadership, and a market for its products and services. All weaknesses were fully addressed.

#### Space Exploration Technologies Corporation (SpaceX)

For the Technical Approach evaluation, the level of confidence rating changed from **White** to **Green**. There were no new strengths identified. All weaknesses were fully addressed, except for weaknesses related to a failure to identify long term development risks; an overly optimistic design schedule; and insufficient information on skills balance to support various NASA and commercial space missions.

For the Business Information evaluation, the level of confidence rating changed from **Green** to **Blue**. No new strengths were identified. All weaknesses were fully addressed.

#### United Launch Alliance, LLC (ULA)

For the Technical Approach evaluation, the level of confidence rating remained **White**. There was one new strength identified for reflecting an effective and integrated S&MA organizational structure. All weaknesses were fully addressed, except for a lack of definition of critical path to an initial launch capability and correlation to CCDev 2 efforts, and failure to adequately describe the association of standard S&MA processes with proposed performance milestones or major design milestones.

For the Business Information evaluation, the level of confidence rating remained **White**. No new strengths were identified. All weaknesses were fully addressed, except for inadequate description of commercial space transportation markets.

After resolution of issues during due diligence, all eight companies submitted acceptable draft Space Act agreements.

#### **IV. Portfolio Selection Decision**

Following the presentation by the PEP, I fully considered the findings presented to me, as well as the information I gained from reading all the proposals, and held an executive session with my advisors to discuss the evaluation results. I asked the opinion of the advisors present and asked for their comments, objections, or concerns with the materials presented. Following this discussion, I compared the proposals against one another to select a portfolio of approaches that best meets the objectives of the CCDev 2 activity, as stated in the Announcement. I explain the discriminating factors and the significance of those discriminators in my selection decision, as follows:

The goal of CCDev 2 is to accelerate the development and availability of U.S. commercial crew space transportation systems by enabling significant progress on maturing the design and development of elements of the system, such as launch vehicles and spacecraft, while ensuring crew and passenger safety. In accordance with the evaluation plan, I considered which proposals had the most effective approach to accomplish this goal and the highest likelihood of successfully executing the proposed approach.

I paid attention to the overall final color ratings the PEP gave to each proposal as an indicator of the proposal's effectiveness and successful implementation. I noted that two proposals received the highest level of confidence color rating (blue) for either the technical or business approach, and several others were rated in the next highest color ratings (green or white) in one or both evaluation criteria. However, these ratings were only indicators and did not form the sole basis of my decision.

I considered how far each company would progress technically under its proposed effort, specifically the degree to which each company would significantly accelerate development of its own concept and accelerate the availability of a U.S. commercial crew transportation system. I also considered the viability of the company's business approach to support and carry out its technical development plan. Then I considered which portfolio of proposals would best meet the goal of the CCDev 2 program within the available total funding.

## **Overall Portfolio Considerations**

As part of my comparative assessment of the proposals, I determined the importance of various evaluation criteria in the Announcement for the purposes of selecting the portfolio, as permitted under the CCDev 2 evaluation plan. As mentioned, all data was considered; however, certain factors were given more weight than others in my deliberations.

For one, I considered the diversity of the portfolio to be of importance. U.S. industry is fairly early in the process of maturing crew transportation systems (CTS). While several proposers have made substantial progress on the development of their CTS concepts, none have progressed beyond a Preliminary Design Review (PDR) level of maturity. In addition, CCDev 2 did not request proposals for integrated, end-to-end CTS. The announcement requested proposals for further development of elements of the system, such as spacecraft and launch vehicles. Although I considered proposers' longer term plans for integration of complete systems, I focused on funding a diversity of CTS element concepts during CCDev 2. I felt it would be premature to significantly reduce competition at this early stage. The benefits of competition among multiple partners are significant, as it incentivizes performance and supports cost-effectiveness. Thus, I considered it to be the most effective use of the CCDev 2 funds to support multiple proposals representing a variety of concepts.

Second, I placed high importance on business considerations. My rationale was that NASA will be a partner in the CTS development, providing significant technical human spaceflight expertise and experience to the awardees throughout the development. However, NASA will not provide business assistance. The awardees will be responsible for "closing their business case" and successfully bringing their systems and services to market. As stated in the Announcement, the goal of CCDev 2 is to develop crew transportation capabilities for both commercial and government customers. To do this, NASA is pursuing an innovative strategy featuring a public-private partnership, with the commercial partner responsible for its own viable business strategy. Thus, I highly weighted proposals that demonstrated a strong business approach.

Third, I weighted spacecraft proposals slightly higher than those for launch vehicles. Within the U.S. industrial base, there is considerable launch vehicle development expertise and experience, as many companies have successfully developed new launch vehicles over the last few decades. In contrast, no U.S. company has successfully developed a crew-carrying spacecraft in over thirty years. Thus, I considered that development of spacecraft was more important in accelerating development of a commercial CTS.

## **Specific Portfolio Considerations**

The Boeing and SpaceX proposals stood out from the rest. Boeing received the highest confidence rating that could be achieved in technical approach, and SpaceX received the highest confidence rating that could be achieved in business approach; meaning that they had a "Very High" likelihood of successfully executing CCDev 2 and a "Very High" likelihood of meeting or exceeding all the goals/objectives of CCDev 2. They were the only ones to receive "Very High" confidence ratings, which I considered significant.

They both showed significant acceleration of the availability of their CTS concepts by reaching an approximate PDR level of maturity during CCDev 2, and they demonstrated a strong commitment to the public-private partnership approach and business considerations. Also, both leveraged considerable prior development work, thereby reducing risks and providing high confidence in their system designs.

Boeing proposed a thorough approach and activities for maturing capabilities during the CCDev 2 performance period, increasing confidence the proposed system maturation will accelerate the overall CTS. They had a very strong technical approach for their system, including an efficient propulsion system, landing concept, propellant for the crew module, and flexibility for optimizing crew and cargo up-mass and down-mass. SpaceX provided a comprehensive description of their methodology behind selecting risks to target during the CCDev 2 timeframe, increasing the effectiveness of their technical approach. Their CTS includes their spacecraft, and their Falcon 9 launch vehicle that enables "test-like-you-fly" operations. For these reasons, all portfolio options that I considered included both SpaceX and Boeing baseline proposals.

Both SpaceX and Boeing proposed capsules as part of their CTS. Given the emphasis on diversity, I considered it important to have at least one lifting body concept in the portfolio. There are significant technical challenges associated with lifting bodies that are not present with capsules; however, lifting bodies offer significant operational capability including cross range performance, ability to land on multiple runways, lower entry g-forces, and quick crew access and egress post landing. At this early stage in the development, I felt it was important to have both lifting bodies and capsules represented in the portfolio.

Both Sierra Nevada Corporation (SNC) and Orbital Sciences Corporation proposed lifting bodies and both were highly rated in terms of their overall color ratings and strengths/weaknesses. However, SNC scored higher in business considerations and demonstrated a strong commitment to the public-private partnership associated with the Commercial Crew Program. Also, SNC's proposal showed more advancement in their CTS concept by reaching an approximately PDR level of maturity at the end of CCDev 2 compared to an SDR level for Orbital Sciences. In addition, SNC's overall CTS concept included a seven crew seat configuration (as opposed to four for Orbital Sciences) which provides flexibility for optimizing crew and cargo up-mass and down-mass by accommodating two to seven crew members and the capability to trade out crew for cargo, increasing confidence in the effectiveness of the technical approach of SNC's CTS concept. Also, Orbital's proposal featured an Atlas V variant that is one of the more robust Atlas V configurations, limiting the growth potential of the spacecraft. SNC's proposal featured a more modest Atlas V variant allowing for more mass growth, increasing the likelihood of being able to successfully develop their CTS concept.

The SNC proposal had a significant weakness in its abort system risk. There remained significant concern on the part of the PEP with respect to the development of appropriate launch abort systems requirements and launch abort system capabilities. Also, SNC did not appear to adequately recognize the importance NASA placed on this risk. However, I felt this risk could be addressed during the development, and given the advantages associated with the SNC proposal cited above, I more highly rated the SNC proposal than the Orbital Sciences proposal.

However, I felt that the proposed baseline level of investment in SNC's concept at this stage was not the most effective use of the limited funding available for the CCDev 2 effort. As each of the participants in due diligence was requested to do, SNC proposed alternate, prioritized milestones that featured a reduced government investment and maintained significant acceleration of their CTS concept. Thus, I selected this option for award.

The remaining participants after due diligence were: ATK Aerospace, Blue Origin, Excalibur Almaz, and United Launch Alliance (ULA). All of the remaining proposers included at least one alternate milestone proposal that was consistent with NASA's remaining funding.

ULA's proposal used existing flight proven vehicles and infrastructure, reducing overall design risk. It also proposed developing an emergency detection system that could be used on different launchers and interface with a range of spacecraft. However, ULA's work content on their existing launch vehicles was not on the critical path for any CTS systems. Thus, it did not accelerate the availability of U.S. CTS capabilities which was a primary goal of the Announcement. In addition, ULA did not adequately describe the commercial market(s) to which it will provide products and services and the plan for marketing and selling company products and services, all key business considerations. Thus, ULA's proposal was not selected.

ATK's proposal was highly rated by the PEP. The company significantly upgraded the quality of their proposal during due diligence demonstrating a responsiveness and technical depth that I valued. ATK proposed advancing the development of a new launch vehicle which they stated could be used by a variety of spacecraft. However, a significant weakness was the lack of a linkage to any spacecraft. ATK did not have any commitments, Memoranda of Understanding, or any partnership details from any spacecraft developer, nor did any spacecraft developer include the Liberty vehicle in their baseline CTS configurations. This was a significant concern on my part as NASA could fund the Liberty all the way through the development phase and there would be the possibility that no spacecraft developer would select that launch vehicle as part of its CTS design, thereby not advancing an orbital CTS concept which was a key goal of the Announcement.

Also, ATK did not provide sufficient details to assess launch vehicle environments on their proposed upper stage or at the crewed spacecraft interface. These environments include areas like coupled loads, staging environments and abort scenarios. Although ATK provided a solid technical approach, their details on environments did not provide me with enough confidence in accelerating this launch vehicle for use with a variety of different crewed spacecraft. I felt it would be a more effective use of the limited CCDev 2 funds to select an additional spacecraft concept in the portfolio. For these reasons, ATK was not selected.

Excalibur Almaz's proposal leveraged an existing crew vehicle structure from the heritage Almaz program which has a long test history; increasing confidence that the concept will accelerate commercial CTS capabilities. It was an innovative and unique approach, and the proposal provided a comprehensive description of their process to evaluate and document overall program/vehicle risks. However, the Excalibur Almaz proposal was the lowest rated proposal of the eight companies selected for due diligence and it was the only one that received a yellow rating (for Business Considerations). In addition, there was a consistent theme in many of the proposal's weaknesses, which was that the proposal lacked sufficient detail to determine crucial




aspects of the CTS concept's technical, business, and safety content. For example, there was a lack of detail regarding the team's engineering and manufacturing experience to fabricate and operate the Almaz vehicle, lack of detail about integration of the vehicle, lack of detail about acquisition of the hardware, and lack of detail about the resources needed for the CCDev 2 work. I felt this lack of detail increased the risk for enabling a commercial CTS capability. This fact, in conjunction with the relatively lower ratings, led me to not select Excalibur Almaz for award.

Blue Origin's proposed concept of flying a moderate lift biconic shape spacecraft offered significant operational capability, thereby reducing overall risk to the crew and enhancing mission success. In addition, the strategy of "walk before you run" with suborbital demonstrations first then orbital demonstrations was realistic and achievable. Also, their business strategy of focusing on commercial crew first and adding complementing markets (e.g., cargo missions) demonstrated their commitment to a commercial CTS capability. Blue Origin demonstrated realism in future markets through diminished dependency on early revenues for sustainability, demonstrating commitment to a long-term strategy that was unique among all proposers. These reasons, along with the weighting for spacecraft, diversity, and business considerations led me to select Blue Origin for award, but at a reduced funding level from their baseline proposal.

I felt this portfolio of companies and CTS concepts is the best overall use of the CCDev 2 funding. Within the selected concepts, there is diversity in spacecraft approaches (two capsules, a lifting body, and a biconic shape spacecraft) and in the launch vehicles they propose to use. All proposals showed an understanding of the importance of safety and a commitment to safe spaceflight. I believe this portfolio will significantly mature the design and development of system elements and accelerate the availability of CTS capabilities.

In light of the discriminators I have described above, I select the following companies for award of funded Space Act Agreements under the Commercial Crew Development Round 2 activity in the following amounts:

Blue Origin:	\$22,005,000
Boeing:	\$92,300,000
Sierra Nevada Corporation:	\$80,000,000
SpaceX:	\$75,000,000

  
Philip R. McAlister  
Selection Authority

4/4/2011  
Date